

Cermet Ceramic Coating on Diamond Dresser for In-Situ Dressing of Chemical Mechanical Planarization

James C. Sung^{*,1,2,3}, Kevin Kan¹

Address: KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

Tel: 886-2-2677-5490 ext.1150

Fax: 886-2-8677-2171

e-mail: sung@kinik.com.tw

¹ KINIK Company, 64, Chung-San Rd., Ying-Kuo, Taipei Hsien 239, Taiwan, R.O.C.

² National Taiwan University, Taipei 106, Taiwan, R.O.C.

³ National Taipei University of Technology, Taipei 106, Taiwan, R.O.C.

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Abstract

In recent years, copper circuitry has been replacing aluminum wires and tungsten via as the dominant interconnections. The polishing of copper circuitry requires using highly acidic solution (e.g. pH = 4) and with strong oxidizing agent (e.g. hydrogen peroxide). In order to withstand the corrosive reactions, the bonding metal of the CMP pad conditioners must be corrosion resistant. Otherwise, it will be dissolved in the acidic slurry that may contaminate the delicate circuitry. Ideally, the diamond pad conditioner is best shielded from contacting with the acidic slurry. The chemical shield must be made of a hard substance so it can withstand the polishing action of the slurry. In addition, this hard substance ought to be highly inert so it will not react with the chemicals in the slurry.

The best chemical shield is diamond-like carbon (DLC) and the second best is ceramic coating. Kinik Company pioneered diamond pad conditioners protected by DLC barrier (DiaShield[®] Coating) back in 1999 (Sung & Lin, US Patent 6,368,198)[1] and there has been no follower since then. Kinik's offered two varieties of DiaShield[®] Coatings: ultrahard amorphous diamond and superhard hydrogenated DLC. Recently, Kink also evaluated Cermet Composite Coating (CCC or C³, patent pending). C³ is unique that the coating composition grades from a metallic (e.g. stainless steel) under layer to a ceramic (e.g. Al₂O₃ or SiC) exterior. The metallic under layer can form metallurgical bond with metallic matrix on the diamond pad conditioner. The ceramic exterior is both wear and corrosion resistant. The gradational design of C³ coating will assure its strong adherence to the substrate because there is no weak boundary between coating and substrate.

By dipping diamond pad conditioners of various designs in acidic solution (e.g. copper cleaning solution) for extended period of time (e.g. 50 hours) the chemical inertness of various matrix materials are determined with the decreasing ranking as: hydrogenated DLC > C³ coating > amorphous diamond > sintered nichrome > brazed alloy > electroplated nickel.